A NEW BDELLOURID-LIKE TRICLAD TURBELLARIAN ECTOCONSORTIC ON MURRAY RIVER CHELONIA

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Synopsis

A new genus is provided for a small acephalous, sedentary turbellarian with posterior adhesive discs, a posterior male complex, and general form resembling *Bdelloura candida*, a maricolous triclad on the gills of *Limulus*. It differs significantly otherwise so that it is a novelty in the Maricola as well as the Paludicola, but is provisionally placed in the latter. "Perigrinatic" is proposed for consortism other than parasitic, symbiotic, and commensal.

This paper describes a triclad turbellarian found in the limb-pits of turtles from a lake near Griffith, N.S.W. As freshwater triclads these would be expected to be Paludicola, but they possess in addition to an anterior adhesive pad, longitudinal marginal adhesive bands and paired posterior adhesive discs. They are acephalous and the single pair of eyes is in a posterior position. These and other features are exceptional in the Paludicola, seen in some Maricola but as yet no Maricola are known from freshwater. The copulatory bursa is situated at the anterior end of the male terminal reproductive organs, dorsolateral to them not fully anterior as in Paludicola, and since the genital pore is posterior, marginal, located between the posterior adhesive discs, the "probursal" condition is possibly secondary. I place these animals provisionally and with much reservation in the Paludicola.

The relationship to the turtles does not fall into the usual consortic categories when these are used in their proper sense, and I propose that it be termed perigrinatic, in the sense of Virgil: "one travelling in a foreign land". There is nothing to indicate that this triclad may not be free-living. It is not parasitic in the sense that it draws nourishment from the host, as does the sanguivorous leech, g. *Placobdella*, which is found with it. It is not symbiotic in the correct usage of this term. There is nothing to indicate it benefits the host or benefits from it. It does not share the food of the host since it is microphagous, and so should not be termed commensal even recognising that this category has become the catch-pot for any kind of consortism which is neither parasitic or symbiotic.

Four specimens came to me from Dr. R. E. Barwick who found them and others along with many egg-capsules in the limb-pits of *Emydura macquarii* and *Chelodina longicollis* taken at Lake Wyangan, near Griffith, N.S.W. during the course of experimental fishing operations carried out by officers of the N.S.W. Inland Fisheries Research Station towards the end of May, 1967.

The stalked egg-capsules immediately recalled those of the bdellourid *Syncoelium* and of some other Planariidae. The animals were fully bdellourid like, even to the presence of two white bodies suitably placed to be the paired copulatory bursae characteristic of this family. It was not until I had studied serial sections that I could persuade myself that these animals could be Paludicola, even though this also gave evidence of characteristics more suited

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to the Maricola than to the Paludicola. Should it later be found that they are maricolous, I see no genus there which will accept them (Hyman, 1951*b*; Grasse, 1961). The absence of a direct connection from the bursa to the exterior excludes them from both the Bdellouridae and the Uteroporidae. Otherwise there is the exceptional g. *Puitcca* in the Procerodidae which has anterior and posterior adhesive discs and a posterior genital pore, but this has the single pair of ovaries in the post-pharyngeal position and lacks a bursa.

If paludicolous, the internal muscle layer of the pharynx includes a circular layer uninterrupted by other muscle cells as is characteristic of the Planariidae and Kenkidae. The latter is restricted to North America and contains white, eyeless cave planarians with resemblance to the g. *Phagocata*. There are only three genera (Hyman, 1951*a*), none suitable for the present species. This presents a combination of characters which I have not found in the various genera of the Paludicola (Hyman, 1951*a*, *b*; Grasse, 1961), and certainly not in the Planariidae. Accordingly, I propose a new genus as below.

Methods

After preliminary study of the live specimens which provided information mainly on the alimentary canal, the animals were narcotised in a drop of water on a slide inverted over a drop of chloroform in a covered petri dish. Then covered with a cover-slip, and 50% alcohol run in under the cover-slip, the rate of flow being regulated to maintain just such pressure as held the animal flat. A specimen was stained in acetic alum carmine, cleared in glycerine, subsequently sectioned at 10 mu. and stained with Delafield Haematoxylin and eosin.

Bdellasimilis, n. g.

Triclad bdellourid-like Turbellaria having a small anterior adhesive pad continuous with narrow longitudinal marginal adhesive bands which expand into two round ventral sucker-like posterior terminal adhesive discs; acephalous; a single pair of eyes placed about $\frac{1}{3}$rd of the length from the anterior end; a single pair of ovaries close behind the eyes, prepharyngeal; copulatory bursa connects by a duct into the penis antrum; testes branching, tubular, preocular and also lateral to the pharyngeal region; sperm vesicles, paired, almost post-pharyngeal; sperm ducts join terminally into a common median duct which connects to the penis where the cavity is central; no bulbar cavity; genital aperture, posterior, median, marginal; no adenodactyl; no genito-intestinal connection; posterior limbs of intestine transversely connected behind peripharyngeal chamber; egg-capsules, stalked, cylindroid.

Type Species.—Bdellasimilis barwicki, n. sp. as follows:

Bdellasimilis barwicki, n. sp.

(Fig. 1, 2)

A whitish or partly grayish, self-coloured, semitransparent, bdellourid-like triclad of small size with a single pair of posteriorly placed eyes, and with obvious paired posterior sucker-like adhesive discs.

Contracted (8·0 mm.) rather bluntly rounded anteriorly, the width about 2·0 mm. at the level of the eyes which are placed about 2·5 mm. from the anterior end; maximum width of 3·0 mm. at the level of the posterior end of the pharynx about 4·0 to 5·0 mm. from the anterior end. The margins then curve obtusely so that the posterior end is obtusely rounded with the two adhesive discs partly showing behind the margin of the body and separated

by a wide and shallow notch where the elongated genital aperture opens ventrally. The body is generally low convex above, flat below. When strongly contracted, the surface shows numerous short striae which are transverse. In extension it may nearly double its length, the preocular region becoming elongate, tapering acutely to the narrow tip but the width and length of the post-pharyngeal region are little changed from the contracted condition.

The anterior adhesive pad is transverse, short, only about 0·08 mm. in length and continuous with the longitudinal marginal bands which are 0·10 mm. wide and run slightly medial to the lateral edge of the body which overhangs them as though an eave. The bands expand posteriorly into the adhesive discs which are 0·3 mm. wide and slightly longer than wide, with narrow raised rims surrounding a flat central area which is richly supplied with eosinophilic gland cells as also in the marginal bands and anterior pad.

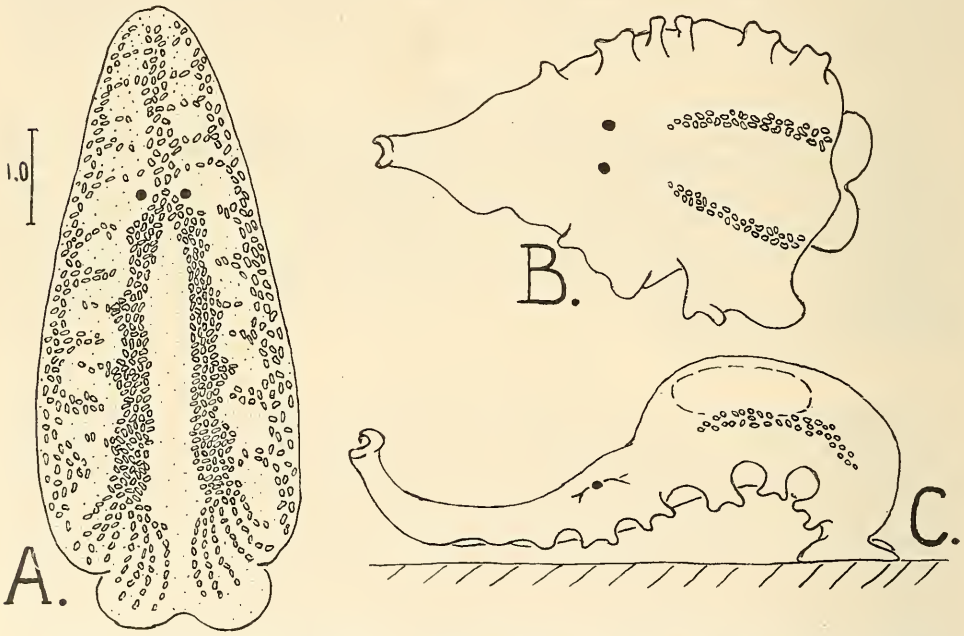

Fig. 1. *Bdellasimilis barwicki.* A. Dorsal view of preserved specimen showing distribution of chromatophores. B. Dorsal and C. lateral views showing the feeding posture. Scale in mm.

The relationship of the rim to the disc is the same as the lateral edge of the body to the marginal band. When the animal is detached from the substratum and placed on its back, the rims of the discs may roll up, thicken, become continuous, presenting the appearance of a single sucker which may be the actual form of this organ: a single wide adhesive pad which appears as two discs because of the emargination of the disc when attached to the substrate.

Seen with reflected light, the animal is whitish excepting for the black and obvious eyes and pale brown chromatophores which are concentrated as a longitudinal row on either side of the peripharyngeal chamber, the two rows converging shortly behind the eyes and extending anteriorly between them as a more diffuse median row nearly reaching the anterior end of the body. Marginal bands of more widely scattered chromatophores run along each side of the body. Between the paramedian row and the marginal row there are scattered chromatophores suggesting possible transverse bars and

others arranged over the posterior region of the body seem to be in radiating lines. It is possible that the dorsum might be patterned when the chromatophores are extended. I have not seen this.

Alimentary System (Fig. 2D.)

The ventral opening into the peripharyngeal chamber is about $\frac{3}{5}$ths of the length of the body from the anterior end. It is transverse, narrowly elliptical to slit-like, and the chamber wider and longer than the pharynx and about $\frac{1}{5}$th of the length of the body. The floor, walls and roof of the chamber are much plicated internally and the whole chamber can be greatly enlarged in the extended animal, especially dorsally as the roof is thin. The pharynx, about $\frac{1}{8}$th of the length of the body is directed posteriorly and in life, I did not see it protruded from the chamber. The pharynx is thick-walled, the parenchyme towards the anterior end is rich in eosinophilous gland cells which are densely packed also around the origin of the limbs of the canal and along the anterior limb nearly to the level of the ovaries. There are only one or two very short small lateral diverticula on the anterior limb between the pharynx and the eyes. Anterior to the eyes there are some seven or eight briefly ramifying elongate tubular diverticula on either side of this limb, short in the sense that they reach only about half way to the margin, and they diminish in length anteriorly. This limb reaches nearly to the anterior end of the body.

The posterior limbs are nearly circular in section as they arch around the anterior end of the peripharyngeal chamber, and depressed elliptical lateral and posterior to the chamber. Lateral to the chamber, they carry a few very small medial diverticula. There is a transverse canal joining the two posterior limbs behind the chamber, followed by more numerous small medial diverticula along the last portion which terminates bluntly near the posterior margin at the level of the end of the penis. The lateral diverticula are more lobed than tubular in their subdivisions, uniform in size along the pharyngeal region and then diminish progressively in diameter and length.

Reproductive System (Fig. 2D, E). (Note: Dimensions given are taken from sections.)

Testes, sperm ducts, vitellaria, and bursa could not be seen in the live animal.

In sections, the testes and sperm ducts appear as a paired ramifying tubular system anterior to the spermiducal vesicles and commencing about 0·75 mm. from the anterior end of the body so that the system is in part preocular. The sperm ducts are somewhat coiling or tortuous, about 0·07 mm. in width in the preocular region and slightly diminished in width as they approach the spermiducal vesicles. The main ducts run just medial to the longitudinal cords of the nervous system. If a side branch from the duct is followed laterally, it closes off in simple blunt-ended tubules and there is no spermatic tissue beyond this. From this, it seems the testes are ramifying tubular lateral branches from the main duct, and openly continuous with the duct. The histology of the contents of both tubules and ducts are the same, both containing spermatocytes and spermatids. The ducts enter the obliquely aligned somewhat ovoidal spermiducal vesicles located lateral to the posterior end of the peripharyngeal chamber. These thin-walled vesicles contain only mature sperm as also the following thin-walled narrow convoluted tubular sperm ducts which are about 0·03 mm. in diameter and extend to the level of the penis bulb when each bends abruptly anteriorly to join into a thick-walled transverse tube about 0·04 mm. in diameter and

with a narrow lumen. From the middle of this tube, a thick-walled median tube with a narrow lumen extends back and enters the penis. There is no bulbar cavity. The canal is central in the penis which is about 0·04 mm. in diameter and 0·12 mm. long, tapering, conical and protrudes into and almost fills the proximal portion of the genital antrum. This antrum expands into a second terminal chamber beyond the end of the penis and the slit-like genital aperture opens ventrally from this second chamber. There is an

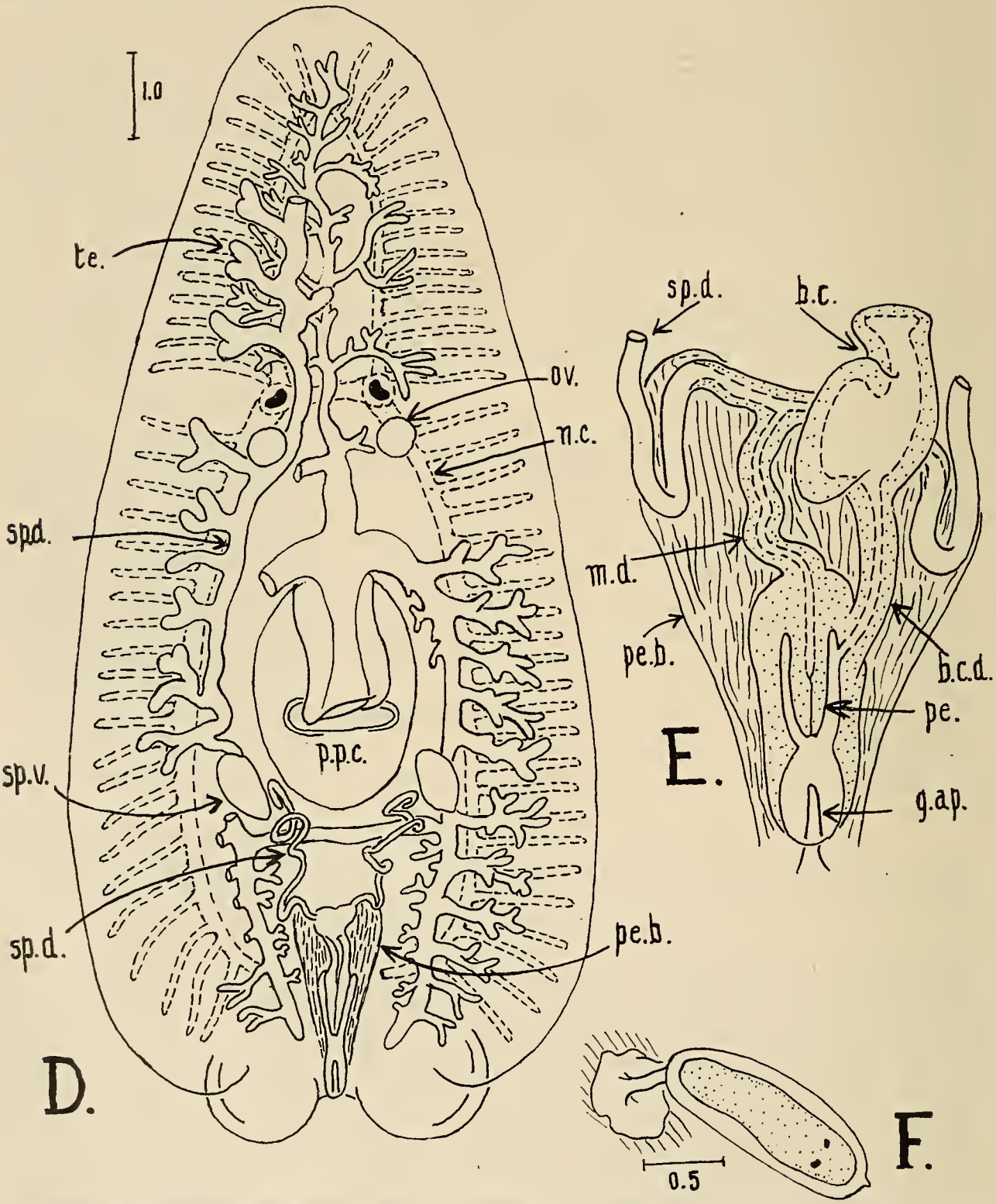

Fig. 2. *Bdellasimilis barwicki.* D. General morphology, composite based on the living specimen, a stained whole mount, and serial sections. E. Free-hand reconstruction from serial sections of terminal male organs, copulatory bursa and duct. F. Egg-capsule. b.c., copulatory bursa; b.c.d., bursal duct; g.ap., genital pore; n.c., longitudinal nerve cord; m.d., median duct; ov., ovary; pe., penis; pe.b., penis bulb; p.p.c., peripharyngeal chamber; sp.d., sperm duct; sp.v., sperm vesicles; te., testis. Scale in mm.

elevation of the dorsal and lateral walls protruding into the antrum as though dividing the proximal from the terminal chamber and leaving them in communication only ventrally; but it is very short and the sections too thick for me to determine the form of this structure.

The single pair of spherical ovaries are situated close behind the cerebral ganglia and the eyes. They are 0·08 mm. in diameter and contain oocytes. The vitellaria show in sections as irregular aggregations of cells chiefly in the region of the ovaries and behind the ovaries, the greater part dorsal above the anterior limb of the alimentary canal, and only some few cells between the diverticula. There is no obvious pattern or distribution which might indicate the path of a duct and I have been unable to detect a duct. The oviducts could not be seen with sufficient regularity to indicate a path and no terminal connections to the reproductive antrum or bursal sac or duct could be found although the wall of both the proximal and terminal portions of the antrum is thickly muscular. There are paired latero-dorsal brief grooves on the inner face of the anterior end of the terminal portion of the antrum suggestive of terminations of oviducts, but these grooves cannot be traced into the muscular wall.

The copulatory bursa was not seen in either the live animal nor in stained whole mounts. In sections it commenced as a slightly widened end to a muscular cylinder about 0·1 mm. in length with a short bulbous caecum on the dorsal aspect so that expanded it might become bilobate. It narrows rapidly to a bursal duct of about the same length. This is thick walled and with a narrow lumen. The duct extends briefly along the dorso-lateral aspect of the penis bulb, enters obliquely to terminate by opening about half way along and into the lateral aspect of the penis antrum. The thick walls of the bursa and duct show no indication of the entry of oviducts and there are no genito-intestinal connections.

The egg-capsules contain only a single embryo. There is an attachment disc of the diameter or wider than the capsule, rather irregular in outline and with some thin raised edges. The stalk is solid, short, cylindrical, its length about equal to the diameter of the capsule which is 0·5 mm. wide and about 1·3 mm. long, terminating obtusely with a minute spike. The colour is brownish; the appearance, chitinoid; the wall, single; the surface, smooth. A short cap detaches by a smooth-edged break running completely around the capsule to release the young.

Type.—Whole mount stained specimen prepared by R. E. Barwick, Coll. No. W 4174, Australian Museum, Sydney.

General Observations

Dr. Barwick noted that although he collected these turbellarians from both *Chelodina longicollis* and *Emydura macquarii*, there were few egg-capsules and these only in the limb-pits of the latter in contrast to such numbers in *C. longicollis* as to be described as dense masses in the order of up to a hundred in one limb-pit alone, and also a few on the skin of the legs elsewhere. On this evidence alone, it is clear there is a continued association between *B. barwicki* and these Chelonia, for he found only a few turbellarians which is suggestive of an extended period of capsule deposition as is known in some triclads.

Of the four live specimens I received, two stayed persistently in the water in the vial; two remained on the lower surface of the cap closing the vial. They did not change position in 24 hours and seem to be strongly sedentary in habit.

The appearance is that of a glossiphonid leech when the body is extended in contact with the surface, but it can be raised to the near vertical with the animal erect on the posterior discs and then the lateral margins are thrown into short rugae as though coarsely frilled. This attitude may be sustained for five minutes and more. There is no movement such as the respiratory movement in leeches when the body is raised clear of the surface.

When stimulated to move over a surface, the motion quite strongly suggests euglenoid creeping. The prepharyngeal region is extended, narrowed, but the pharyngeal and postpharyngeal regions are not greatly reduced in width or length. The prepharyngeal region then widens and shortens and the posterior region is drawn forward. It is not a rapid movement. I did not see it exhibit typical smooth turbellarian progression. Various attempts to persuade the animal to swim were unsuccessful. When dropped into water, it sank slowly to the bottom, rolling up and unrolling lengthwise and partly twisting the anterior portion of the body, but with no control. In this it differs from *Bdelloura candida* which is a capable swimmer (Verrill, 1892).

When detached from the surface and placed on its back, it is unable to right itself. One was held in water in a watch-glass for three hours in this position. During this time, it rolled up lengthwise repeatedly and extended in attempts to find a hold for the anterior adhesive pad, but with no success. It seemed to have no ability to twist the anterior portion of the body sufficiently to obtain a hold. The posterior end of the body has even less flexibility. The level of the water was reduced until the surface film was within the reach of the animal but it made no attempt to utilise this to re-orientate itself. In this inability to right itself, *B. barwicki* contrasts with other Paludicola and with such Maricola as I know.

It is a most difficult animal to manipulate. When detached from the surface by a needle, the body is wrapped lengthwise or crosswise on the needle adhering by the marginal bands, the anterior pad and posterior discs. It cannot be shaken from the needle or displaced by even violent agitation in water. As the animal is in fact firm bodied, it can be handled by using two needles, transferring it from one to the other until it is moved to the point of a needle, and it is unable to maintain a hold on this.

It is unusually light sensitive. An abrupt exposure to direct bright light leads to strong contraction, and a gradual relaxation when the light is turned off. When this is repeated several times, the animal acts as though conditioned and remains contracted for ten to twenty minutes with the light turned off. It does not respond to light from below even with very much higher intensities than produces contraction with direct light above. The pigmented optic cups open dorsally which apparently shields the light-sensitive retinal structures from light from below. I have not found this response in *Dugesia* or *Curtisia* spp. which I have known elsewhere.

B. barwicki has a distinct feeding posture (Fig. 1C). Attached by the posterior adhesive discs, the body is raised and held parallel to the substratum. The postocular region is convex in profile; the extended preocular region, concave above with the margins of the body rolled ventrally to form a furrow which is open at the anterior tip of the body. The lateral margins are undulate to irregularly rugose but without movement. The peripharyngeal chamber is enlarged and obvious through the thin body wall roofing over it. At intervals as frequent as ten minutes, the margins of the preocular region are folded inwards, the body raised slightly as a whole, and the preocular region curved ventrally and passed back under the ocular region and to the

back of the pharyngeal region, the whole as though forming a sac beneath the peripharyngeal chamber. This attitude is held for a matter of a minute or so, and then the former stance is resumed.

During this action, the opening of the peripharyngeal chamber is large, twice and more the width of the pharynx, and the latter swings from side to side, extends and shortens, as though probing all regions in the peripharyngeal chamber. On one occasion, a considerable mass of unicellular green algae was accumulated in the enlarged peripharyngeal chamber. The margin of the enlarged opening into the chamber was thickened, as though a band holding the mass of algae within the chamber while the pharynx probed around and into it.

This manner of feeding suggested the possibility that there might be something here of the nature of a ciliated mucous filter feeding mechanism based on the mucus secreted from the anterior pad and marginal bands; but I could not detect any signs of currents of water moving toward or away from the animal such as would be expected in the presence of this type of feeding mechanism. In fact, I was not able to detect any indication of external ciliation in the live animal. The mass of uncellular algae in the peripharyngeal chamber seemed to be a loosely formed accumulation and the pharynx seemed to move freely into and through it with no indication that the algae were trapped in mucus.

Acknowledgements

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